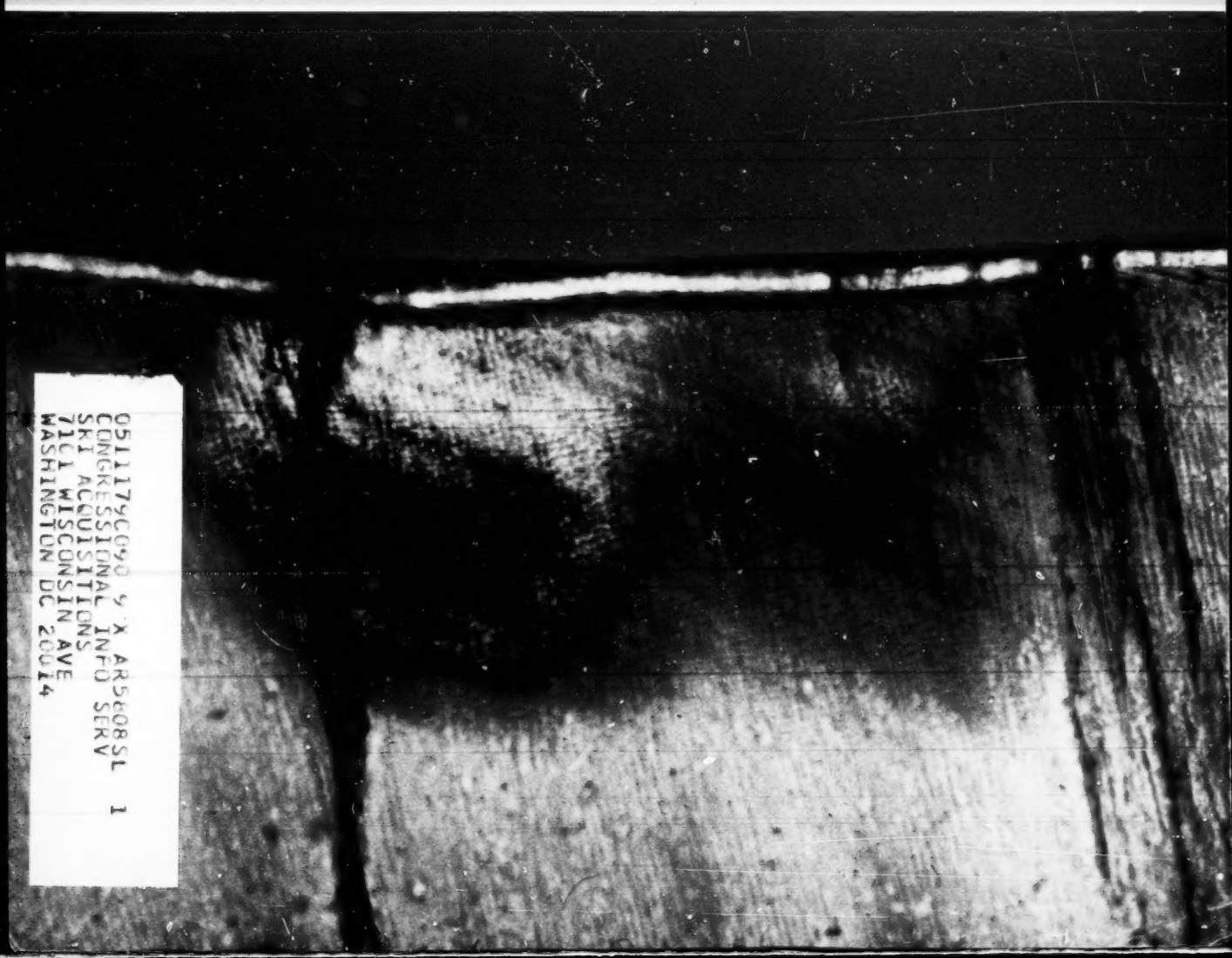
Chemical & Engineering NEWS
February 25, 1980

Sulfuric and phosphoric acids face strong year A Key Chemicals Review Page 10

TOOTH DECAY

A preventable disease Page 30



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Cover: Section of a decayed human tooth viewed by polarizing microscope. Yellow region is partially demineralized area below the enamel surface. Blue-green region is the intact enamel. Photo courtesy of Leon M. Silverstone of the University of Iowa college of dentistry

4 Letters

Concentrates
9 Business
21 Government
25 Science/Technology

The Departments
43 ACS News
56 Newscripts

News of the Week

- ***A new model for DNA replication,*** *proposed by cancer researchers, may help in understanding the differences between nuclei of normal and cancerous cells.* **Page 6**
- ***The U.K. has set quotas*** *on the amount of polyamide and polyester fiber yarns that can be imported from the U.S.* **Page 7**
- ***CEQ says quality of U.S. water supply*** *is major problem, cites contaminated ground and surface water, acid rain.* **Page 7**
- ***Supreme Court will not hear*** *Berkey Photo's appeal of a lower court reversal of antitrust judgment against Kodak.* **Page 7**
- ***Three chemical waste haulers were indicted*** *by a New Jersey grand jury for dumping acid wastes.* **Page 8**
- ***Three coal gasification projects*** *are moving the technology toward broader commercialization.* **Page 8**

Business

- ***Outlook for big-volume acids sulfuric and phosphoric*** *is good; demand is high and prices are rising.* **Page 10**

International

- ***Earnings of Canada's largest chemical firms*** *increased substantially over 1978 figures; strong worldwide demand for petrochemicals was a big factor.* **Page 14**
- ***Canadian petrochemical producers*** *eye U.S. as prime target of export market as major complexes boost capacities.* **Page 15**
- ***Japan will have to import petrochemicals*** *until its joint venture with Saudi Petrochemicals comes on stream.* **Page 16**
- ***U.S. chemical investment in Western Europe*** *will continue as will European investment in this country.* **Page 16**

Government

- ***Congress works anew on money and energy bills;*** *windfall profits tax progressing, disagreement dogs energy bills.* **Page 22**
- ***House subcommittee*** *blasts DOE's proposed nuclear program cuts, especially HTGR and breeder reactor.* **Page 24**

Science

- ***National Bureau of Standards*** *sees demand for more data, begins grants program to spur scientists to this work.* **Page 26**

Technology

- ***Morpholine may be the next item*** *on Air Products' production line, along with coproduced 2-(2-aminoethoxy)ethanol.* **Page 28**
- ***Process to make medium-Btu gas*** *from coal, municipal solid waste, and sewage sludge is ready for pilot-plant stage.* **Page 28**

Special Report

Research on the causes of tooth decay *is leading to development of methods to prevent a disease that costs Americans about $6 billion a year.* **Page 30**

Prosperity continues for big-volume acids

Sulfuric acid demand grows faster than forecast and phosphoric acid pushes limits of capacity; prices for both acids are increasing

Even with a number of uncertainties, 1980 is shaping up as another banner year for the big-volume U.S. mineral acids—sulfuric and phosphoric. Production will be up. Price increases might do more than just pass through inflated materials and energy costs. And prospects for capacity expansions will brighten.

Two strong forces produce the sunny outlook for these acids—another good market year for U.S. fertilizer, the dominant end product, and a boost from exports. Exports are being watched closely by the U.S. government, which must approve any large-scale phosphate product shipments to the Soviet Union. But to date, no shipment of such product has been blocked.

The fertilizer prosperity in 1979 and 1980 continues its pattern over the past 15 years of appearing late in the overall U.S. business cycle. Trailing the general business expansion, fertilizer tends to hit its stride toward the end and sometimes, as in 1974 and 1975, carries right into the following recession. This year, fertilizer could do it again, if forecasts of a recession in the U.S. in the second and third quarters prove correct.

For phosphoric acid, capacity limitations actually will hold down sales expansion. Currently, phosphoric acid plants are being used at rates above normal limits.

Sulfuric is being produced below full capacity use nationwide. However, at some locations, such as major phosphoric acid sites in southern Florida, sulfuric acid production is close to capacity.

Such good times are not without problems, not the least of which is still questionable profitability. Certainly, price increases at the beginning of 1980 following others during 1979 have pushed contract selling prices for these acids way above year-earlier levels. But these price increases often have not covered cost increases. Much of the price increases for big-volume acids reflect added fuel costs.

With such value jumps, the big acids are a giant business. These acids could have a total production value exceeding $7 billion in 1980—more than $3 billion for sulfuric acid and nearly $4 billion for phosphoric acid. Sulfuric acid is the largest-volume chemical produced in the U.S., and phosphoric acid is ninth largest.

Yet, few chemicals are actually as cheap per ton as these acids. At the high side of the current contract price range, sulfuric acid costs just 3.5 cents a lb. Phosphoric acid costs about five times as much but is still among the less expensive major chemicals.

The low cost of sulfuric acid relative to its valuable properties as a powerful acidulator or catalyst makes it one of the better values among industrial products. As a result, sulfuric acid is one of the most widely used chemicals, but its dominant outlook is for making phosphoric acid.

Phosphorus' importance in growing crops lies behind the unprecedented demand for phosphoric acid. This property also leads to the major uncertainty this year in demand. So far, in spite of the political effects on export potential, fertilizer exports have shown no significant drop. Nor has U.S. demand slackened in the face of rising fertilizer prices and uncertainties about sales volume of feed grains.

But with such strong demand for phosphoric acid, why aren't there more capacity expansions? Partly because producers remember the most recent big round of capacity expansion, which ran into a sudden slowing of phosphate fertilizer sales. A producer shakeout followed in the mid-1970's. Producers may not yet want to take a chance on major investment.

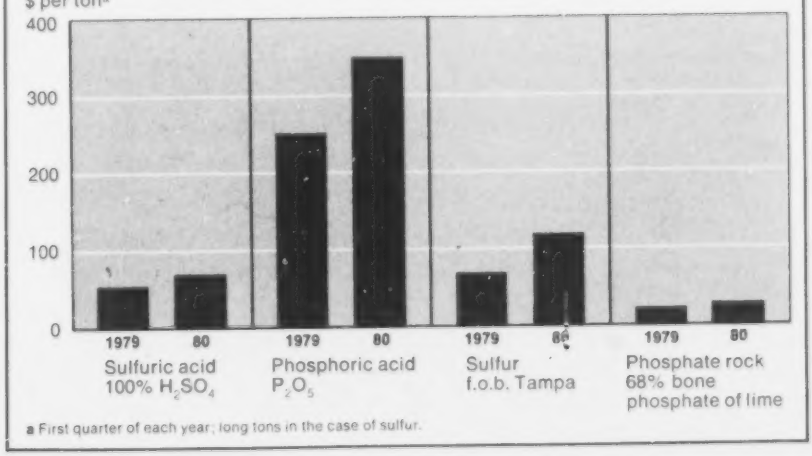
As with most other large-volume chemicals, plants for these acids must be large and complex to be most economical. Typically, a sulfuric acid plant feeds a nearby phosphoric acid plant that feeds a nearby derivatives plant. A relatively small part of the total material fed to the complex comes out as product. Materials-handling equipment for phosphate rock and unwanted coproducts account for a large share of the cost of fertilizer complexes.

The large-scale operation of a phosphoric acid plant accounts for a large part of the relatively high value added in phosphoric acid compared to raw material phosphate rock. Among starting materials, phosphate rock typically makes up only 20% and sulfuric acid 33% of the final product cost.

For additional details of the outlook for these two major-volume mineral acids, see the following pages.

Bruce Greek, Houston

Prices have shot up for the big acids and their raw materials



a First quarter of each year; long tons in the case of sulfur.

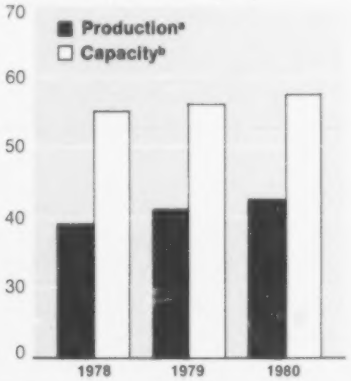
H_2SO_4

Sulfuric acid

- ***Demand improving***
- ***Capacity growing***
- ***Prices rising***

PRODUCTION/CAPACITY

Millions of tons, 100% H_2SO_4



a From all sources. b First quarter.

HOW MADE

Elemental sulfur burned to the dioxide, oxidized to trioxide, and reacted with water; sulfur dioxide recovered from nonferrous metals smelting, oxidized to trioxide, and reacted with water

MAJOR END USES

Fertilizers 65%, chemical manufacture 5%

FOREIGN TRADE

Exports—less than 100,000 tons per year, imports—less than 400,000 tons

PRICES

Posted contract prices $65 to $75 per ton as 100% H_2SO_4

COMMERCIAL VALUE

$3 billion for total production, 1980; $2.5 billion, 1979

The workhorse of the chemical industry, sulfuric acid, is getting more and more expensive because it is being fed more expensive "oats," that is, sulfur. Price escalations for sulfur are being passed along rapidly by sulfuric acid producers, who have pushed up their prices roughly a third in a year's time.

Yet these prices in no way seem to reduce demand for sulfuric acid. When all the 1979 statistics are in, production of sulfuric acid may have topped 41 million tons, an increase of 4%. Such an increase, although not so large as in 1978, still was more than many industry observers forecast for 1979.

Some sources believe that 41 million tons might be too low an estimate for 1979 production. A top level for production might be 41.5 million tons for 5.5% growth.

For 1980, forecasts for sulfuric acid output carry provisos for the uncertain U.S. economic situation and export unknowns in phosphoric acid and phosphate fertilizers. The forecast range for production runs between just over 41 million tons for a 1% gain to 44 million tons for a 7% gain.

Sound reasoning underlies both the low and high forecasts for 1980 production. The low forecast takes into account a moderately severe U.S. recession, a small cutback in U.S. fertilizer use, and a loss of exports of phosphoric acid and derivatives to the U.S.S.R.

The high-side forecasters are impressed by the boom in sulfuric acid's main market, phosphate fertilizer. After a good farm year in 1979, U.S. fertilizer production and consumption could be up substantially in 1980. Both U.S. use and exports are likely to help fertilizer demand. So far, any U.S. recession, if there is one, has not affected other major use areas of sulfuric acid such as petroleum refining, although growth in these uses remains small.

Even if production of sulfuric acid in 1980 reaches 44 million tons, nameplate plant capacity of 57.5 million tons as of the first quarter will not be strained. Something over 1 million tons of annual capacity is estimated to have been added during 1979 based either on elemental sulfur or on by-product smelter gases. More capacity, mostly through debottlenecking, will be added during 1980. However, the new capacity total will be small, perhaps about 300,000 tons.

If production of sulfuric acid in 1980 reaches the midpoint of the forecast range, capacity use will be about 75% of the nameplate total. This is a bit more than recent rates but still well below the top rates of the mid-1960's, which reached 95%.

Most of the new capacity based on elemental sulfur and a large part of the new smelter-acid capacity will go to make phosphoric acid and its derivatives for use in fertilizer. In 1980, about two thirds of U.S. sulfuric acid production will go to make fertilizers. This use pattern is the reverse of 20 years ago, when fertilizer took one third of a much smaller sulfuric acid output of about 17 million tons.

Even with its large-volume position among uses of sulfuric acid, phosphate fertilizer has one of the larger growth rates, about 5% in 1980. Small use areas such as copper leaching or processing of uranium or vanadium ores might have larger growth rates, but their base is tiny compared to that of fertilizers.

Fertilizer use of sulfuric acid is expected to continue to grow faster than will fertilizer production. The reason is that the quality of phosphate rock acidulated to make phosphoric acid is trending down. That is, to make the same quantity of phosphoric acid from lower-quality rock, more sulfuric acid will be needed. The exception would be if new technology for beneficiating the rock as it is mined proves more economical than added use of sulfuric acid in phosphoric acid plants. Resolving this issue probably will take a decade or more.

Because of slippage in phosphate rock quality, chances are small that consumption of sulfuric acid in 1980 will drop. A more than modest gain seems assured even with fast-increasing acid prices rising in line with prices of raw material sulfur.

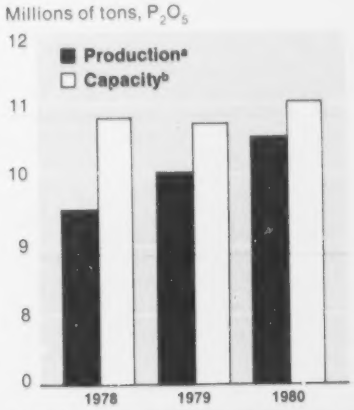
If demand for derivative phosphate fertilizer continues strong, a bit of market juggling may result. Fertilizer exports probably will have to slow down during the U.S. planting season this spring but perhaps will be made up later, the government willing in some cases. None of this would hurt sulfuric acid.

Phosphoric acid

H_3PO_4

- ***Demand strong***
- ***Capacity expanding***
- ***Prices rising***

PRODUCTION/CAPACITY



a Includes wet-process and furnace acids.
b First quarter.

HOW MADE

Reaction of phosphate rock and sulfuric acid, burning of phosphorus and reaction with water

MAJOR DERIVATIVES

Ammonium phosphate 60%, superphosphate 20%

MAJOR END USES

Fertilizer 80%, detergents 5%

FOREIGN TRADE

Exports—could exceed 1 million tons as P_2O_5; imports—very small

PRICES

$350 per ton (100% P_2O_5) for fertilizer use, other grades up to $550

COMMERCIAL VALUE

$3.8 billion for total production, 1980; $3.0 billion, 1979

In 1979 farmers found that phosphoric acid derivatives in fertilizers, the dominant market, were in tight supply and had high prices. There is no new twist for 1980—tight and dear is still the rule for phosphoric acid and products made from it.

Producers of phosphoric acid by the main "wet" process (reacting sulfuric acid with phosphate rock) generally are pushing their plants at capacity, if not a bit over. The production rate hit another record in December 1979 at 880,000 tons of P_2O_5, equivalent to an annual rate of 10.6 million tons, according to the Fertilizer Institute.

This production rate can't be sustained for 1980, several industry sources say. But the actual rate could come close if new capacity in 1980 runs well and no feedstock problems develop. Probably a combined total of about 10.5 million tons (P_2O_5) of wet-process and furnace acid will be made during 1980. Of this, about 9.9 million tons will be wet-process acid. Something under 700,000 tons will be furnace acid, as this process's slow production decline continues.

Capacity for wet-process acid has begun to expand again after a five-year pause. The pause followed an almost disastrous jump in capacity in 1974–75 coupled with slack sales growth. A small amount of new capacity came on stream in 1979, bringing nameplate capacity to about 9.6 million tons (P_2O_5). This year another 500,000 to 600,000 tons should start up.

Furnace acid nameplate capacity is flat at about 1.4 million tons a year (P_2O_5). Use of this capacity has dipped under 50% recently. As production of this type of phosphoric acid declines further, some capacity may be shut down. However, all of it is old and the original investment has been fully returned. Hence there is an incentive to run these plants as long as demand remains for the high-grade acid product and as long as the elemental phosphorus raw material isn't needed in making something else.

Longer-term, if these old plants disappear, there should be no real problem for consumers of high-grade acid. Technology has been developed and is being refined to produce very-high-quality phosphoric acid by purifying the standard lower-quality wet-process acid.

In sum, total domination of phosphoric acid production by wet-process technology is coming. Even now, wet-process variables are the key to phosphoric acid supply.

Wet-process acid production is becoming slightly more difficult each year. The problem is a gradual decline in the average phosphorus content of remaining U.S. phosphate rock. The decline is the result of using the best-quality rock first as the most economical and then going to lower-quality supplies.

As rock quality declines, phosphoric acid plant capacity declines. More rock must be processed to produce the same quantity of phosphoric acid. More sulfuric acid is required. More by-product gypsum is produced. And more material moving through the plant adds costs in energy, equipment, and labor. Excluding all other costs, such as energy, the increase in material throughput alone will cause prices of phosphoric acid and its derivatives to rise continuously over the long term.

Capacity expansion then could be less than the figures show and certainly more expensive. Debottlenecking will help preserve capacity, but new units will be needed eventually. These units will cost substantially more because of their increased size for the given capacity.

To pay for incremental expansions and new plants, profits from phosphoric acid and derivatives should increase, producers say. So far, most producers are getting proportionate coverage of cost increases in selling price increases. This isn't hard with all wet-process plants operating at capacity.

Even so, producers are concerned about buyer resistance this spring in the face of large increases in fertilizer prices. Resistance is expected to stiffen as farmers find out some of their other cost jumps this year, notably for diesel fuel.

Despite these fears, fertilizer producers have no choice but to pass along their large cost increases for phosphoric acid. In turn, phosphoric acid producers hope to pass along their own cost increases and a bit more. If they ever had a chance to do this, it is now.

Canadian chemicals post solid gains in 1979

Strong fourth quarter caps year of dramatic growth in sales and earnings for four major firms; profit margins more than doubled from 1978

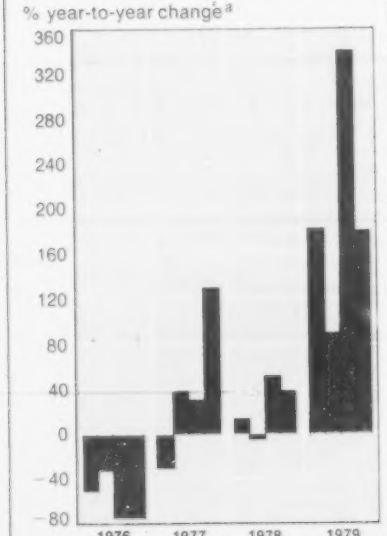
All of Canada's four largest publicly reporting chemical companies—Canadian Industries Ltd. (CIL), Celanese Canada, Du Pont Canada, and Union Carbide Canada—were in pretty good shape at the end of 1979.

Big new plants and a favorable feedstock situation have made Canada a significant contender in world petrochemical markets; exports are booming. Sales and earnings reached record heights. But there's some concern that business will level off in 1980.

Combined fourth-quarter sales for the four companies amounted to nearly $743 million (Canadian), a 23% increase from fourth-quarter 1978. Combined earnings, excluding extraordinary items, rose to $51.4 million, 178% higher than in the 1978 period. For all of 1979, sales increased 26% from 1978 levels, to $2.8 billion. Net income totaled $174 million, a 175% gain. Profit margins, overall, increased by a factor of about 2.2.

CIL fourth-quarter sales were $219 million, a 20% increase from the like period in 1978. Ordinary net income came to $7.0 million, up 94% from a year earlier. For the full year, sales rose 18% from 1978 to $880 million. Net income amounted to $36.3 million, a 38% increase. However, CIL's net for the fourth quarter and the year was sweetened by a $12 million extraordinary gain from the company's sale of its interest in a real estate development venture.

Fourth-quarter earnings reflect continued recovery



a After-tax earnings of four largest publicly reporting Canadian chemical companies—Canadian Industries Ltd., Celanese Canada, Du Pont Canada, and Union Carbide Canada.

Among the four companies, CIL continues to be the leader in sales (just barely) but the laggard in profitability. Return on sales was 3.1% for the fourth quarter and 4.1% for the year, compared to 2.0% and 3.5% in the respective 1978 periods. Performance was adversely affected by a long strike at International Nickel, a major CIL customer and supplier.

Celanese Canada's fourth-quarter sales came to $99 million, up 19% from the fourth quarter of 1978. Net income for the period was $5.5 million, a 62% increase. But that figure was reduced to $2.5 million by a $3 million write-off of remaining goodwill in discontinued polyester fiber operations. Sales for the year totaled almost $354 million, a 22% increase from 1978. Net income (excluding the extraordinary loss) reached $21.2 million, 221% higher than in 1978. Profit margins also improved substantially; 5.6% for the fourth quarter and 6.0% for the year, compared to 4.1% and 2.3% in the like 1978 periods.

Du Pont Canada likewise showed healthy improvement. Sales for the quarter amounted to $233 million, a 25% increase from the 1978 period. Net income was $18.5 million, a more than ninefold increase from an admittedly lackluster fourth quarter in 1978. For the year, sales reached $880 million, a 33% increase from 1978. Net income climbed to $59 million, up 478% from the preceding year. Profit margins were 7.9% for the quarter and 6.7% for the year, compared to only 1.0% for the quarter and 1.5% for the year in 1978. Du Pont attributes much of the improvement to strong export sales, which rose 49% from 1978 levels.

Union Carbide Canada, which was in decline during much of 1978, continued the turnaround that began in last year's fourth quarter. Carbide sales for the fourth quarter of 1979 totaled $192 million, a 23% increase from the fourth quarter of 1978. Earnings rose to $20.4 million, up 113% from the 1978 period. For all of 1979, sales amounted to $686 million, 30% ahead of 1978. Net income rose 188%, to $57.8 million.

The company is still the most profitable of these four companies. Return on sales was 10.6% for the fourth quarter and 8.4% for the year, compared to 6.2% and 3.8% in the corresponding 1978 periods. Carbide says the earnings gain resulted largely from strong domestic and international demand for petrochemicals. This strong demand allowed prices to recover from the depressed levels of the preceding three years.

Ward Worthy, Chicago

Combined earnings of four firms rose 175% in 1979

$ Millions (Canadian)	Net sales 1979	Change from 1978	Net income 1979	Change from 1978	Profit margin[a] 1979	Profit margin[a] 1978
Canadian Industries	$880.0	18%	$36.3[b]	38%	4.1%	3.5%
Celanese Canada	353.6	22	21.2[c]	221	6.0	2.3
Du Pont Canada	879.6	33	59.0	478	6.7	1.5
Union Carbide Canada	685.9	30	57.8	188	8.4	3.8
TOTAL	$2799.1	23%	$174.3	175%	6.2%	2.8%

a Net income as percentage of sales. b Excluding extraordinary gain of $12.0 million. c Excluding extraordinary loss of $3.0 million.